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Dazzi C.

in

Papanastasis V. (ed.), Stringi L. (ed.).
Fodder trees and shrubs

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 4

1994
pages 135-142

SOILS OF PIETRANERA FARM: THEIR FEATURES AND CAPABILITY IN RELATION TO SHRUB CULTIVATION (°)

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SUMMARY

This work deals with the soils on Pietranera farm (Sicily - Italy) which have been classified according to Soil Taxonomy. From a soil survey of the farm the following soil orders were identified: Entisols, Inceptisols, Vertisols. Some areas with rock-outcrop, badlands and landslides were also mapped.

The capability of these soils is very limited by several hazards which are mainly linked to erosion, salinity, morphology and vertic features. As a consequence the cultural choices must be very shrewd.

INTRODUCTION

Soil surveys and the definition of the interrelation among soil, climate and vegetation are very helpful to planners. This is particularly true in an agronomical area where soil surveys constitute the bases in technical choices, such as the crops, the type of fertilizer, tillage or irrigation system (Fierotti *et al.* 1982).

The more detailed the soil survey, the more accurate the choice. A soil survey carried out at farm level gives the best results.

In this note, which was arranged for the international meeting on "Forage shrubs, breeding and methodology" held at Pietranera farm, are reported the main features of the soils at the farm, as they were illustrated during the field visit.

(°) The soil surveys were conducted with funds of the Italian National Council of Research for the project "Soil Conservation"

THE FARM ENVIRONMENT

Pietranera farm lies in the south-eastern limit of the Sicani range. It occupies an entire hill about 700 hectares wide and is surrounded by streams (Dazzi, 1982). Its morphological features are very similar to the wide Sicilian hilly inland i.e. flat areas near the streams and slopey areas on the central part of the hill. The slopes are sometimes very steep and badland areas appear. The average annual rainfall is about 500 mm: summers are long and dry (about five months), winters are rainy and mild. The average annual temperature is 17-18°C. The climate according to Thorntwaite, is semiarid. The soils thermoudometric regime is thermic and xeric respectively (Oliveri *et al.* 1986).

THE SOILS ON THE FARM

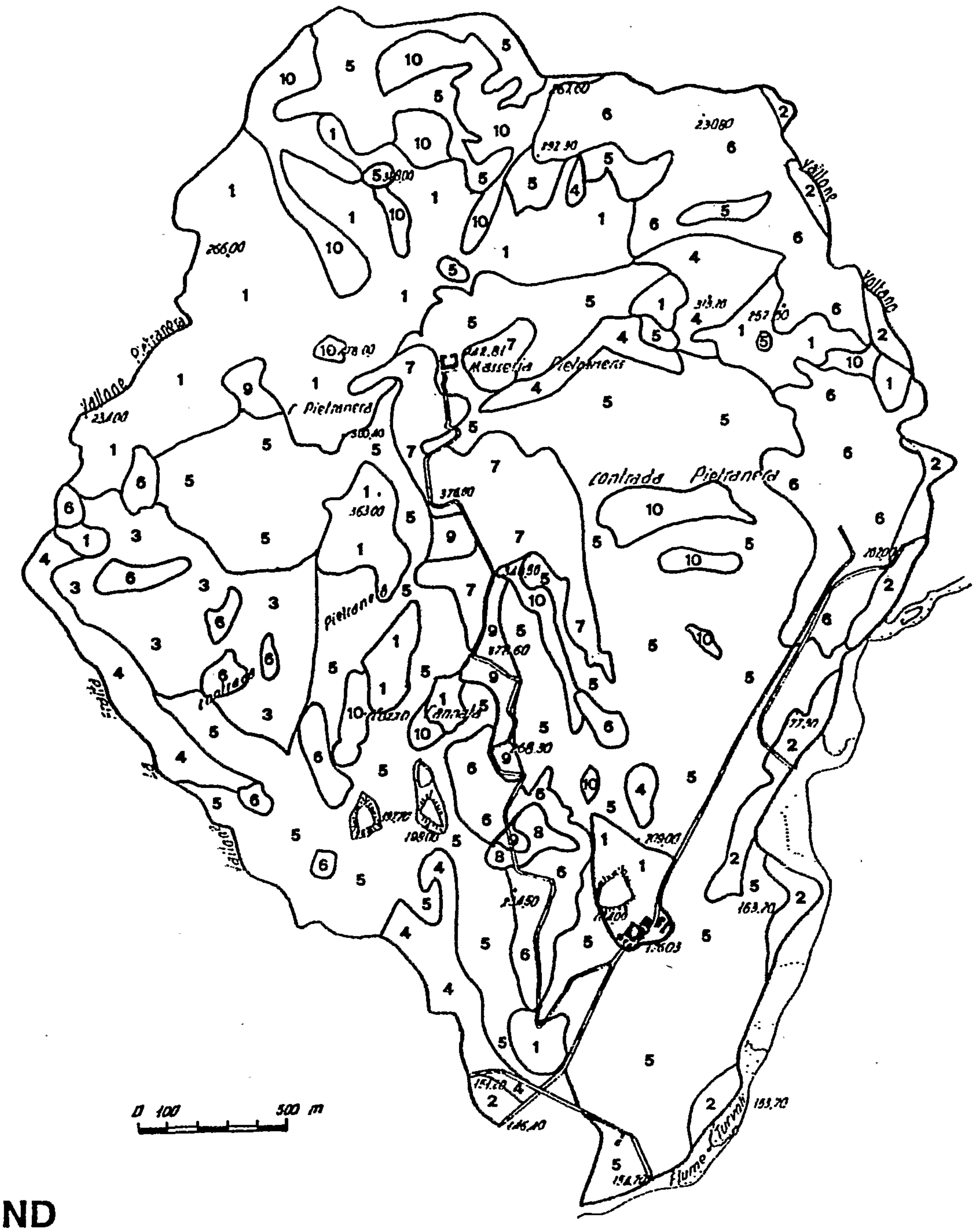
A soil survey of Pietranera farm showed three different soil Orders: Entisols, Inceptisols and Vertisols (Alliata e Dazzi, 1986; Dazzi e Raimondi, 1986; Oliveri *et al.*, 1986; Raimondi e Dazzi, 1986). There are also intergrade soils between Inceptisols and Vertisols (Oliveri *et al.*,1986).

ENTISOLS

The Entisols (Fig. 1) occupy a surface of approximatively 140 hectares and belong to the following Suborders (Alliata e Dazzi 1986): Typic Xerofluvents and Typic Xerorthents.

The first type evolve on alluvium and is characterized by a deep soil profile of Ap-C type. Its texture ranges from clayey to clayey-loam, though sandy-clay-loam can be found in the deeper horizons. It shows a good sub-angular blocky structure and a sub- alkaline reaction. The carbonate content, which sometimes forms concretions, is always good. It is moderately supplied with organic matter and phosphorus, low in nitrogen and rich in potassium. The drainage tends to be slow in the deeper horizons. In some cases the amount of stony fragments and the salinity level are so high as to determine a stony phase and a salty phase.

The Typic Xerorthents evolve on different substrata and show a shallow Ap-C soil profile which is sometimes extensively eroded and the



LEGEND

1	TYPIC XERORTHENTS
2	TYPIC XEROFLUVENTS
3	TYPIC XEROCHREPTS
4	CALCIXEROLLIC XEROCHREPTS
5	VERTIC XEROCHREPTS
6	TYPIC CHROMOXERERTS
7	TYPIC PELLOXERERTS
8	CHROMIC PELLOXERERTS
9	INTERGRADE BETWEEN VERTIC XEROCHREPTS & ENTIC PELLOXERERTS
10	ROCK OUTCROP or BADLANDS or LANDSLIDES

Fig. 1 - Schematic soil map of Pietranera farm (Sicily - Italy).

relative soil phase appears. The texture is clayey; the structure is sub-angular blocky and tends to be massive in deeper soils. The reaction remains at sub-alkaline levels. The carbonate content is usually more than adeguate while the fertility elements are occasionally insufficient. Drainage, which is normal in the topsoil, becames very slow in the subsoil.

Generally speaking Entisols on Pietranera farm are young soils which show a poorly evolved soil profile. They are on different morphologies and are sometimes subject to strong erosion and high salinity levels. Consequently the capability of these soils is restricted by the hazards to which they are exposed, mainly erosion, and salinity and in sub-order stoniness, rockiness and in the case of Typic Xerorthent also by their shallowness.

INCEPTISOLS

The Inceptisols cover a surface of approximatively 370 hectares (Fig. 1). They belong to the following Suborders: Typic Xerochrepts, Calcixerollic Xerochrepts, Vertic Xerochrepts (Raimondi e Dazzi 1986).

Typic Xerochrepts evolve on marls and show a very deep soil profile with an Ap-Bw-C sequence. Their texture is clayey and their structure, which is crumby on the surface becomes blocky in the subsoil.

The reaction is always sub-alkaline and the carbonate content is, at times, excessive. On the whole these soils are low in organic matter and in fertilizing elements. The drainage becomes slower as depth increases. In some areas a salty phase appears.

Calcixerollic Xerochrepts also evolve on marls but their profile is fairly deep with an Ap-Bk-C sequence. The texture is clayey; the structure is sub-angular blocky becoming massive in the deeper horizon.

These soils show a sub-alkaline reaction and an excessive carbonate content which take on the form of concretions in the subsoil. Generally their organic matter, nitrogen and total phosphorus contents are all low; they are averagely well-supplied with both assimilable phosphorus and potassium.

Drainage is always low. It is important to note the presence among Calcixerollic Xerochrepts of a stony phase, a rocky phase and a salty phase. Vertic Xerochrepts are the most diffused soils of the farm. They can be subdivided, according to their morphology, in two groups.

The first group is found on alluvium and is characterized by soils with an Ap-Bw-C profile showing a solum depth of about 100 cm. They have a clayey texture and a sound blocky structure that changes to prismatic in B horizon. The reaction is always sub- alkaline while the carbonate content is, at times, excessive.

The second group evolves on the sloped areas (from moderate to steep) of the clayey hill. The soil profile, of Ap-Bw-C type, is moderately deep; the texture is clayey; the structure is subangular blocky in the topsoil and prismatic in the subsoil.

On the whole, both these soils are low in organic matter and in nitrogen and averagely well supplied with phosphorus and potassium. Drainage tends to be slow. Some areas are affected by rockiness or stoniness with, salinity, erosion, and drainage problems so that the relative phases can be identified.

The capability of Vertic Xerochrepts, particularly in sloped areas is restricted by erosion, salinity and vertic features (cracks) which cause rapid soil dryness from the beginning of the dry period. To overcome these limiting factors, erosion and salinity must be controlled and suitable crops should be adopted (crops with a short cycle and with a good tollerance to soil salinity and drought).

VERTISOLS

From a soil survey (Dazzi e Raimondi, 1986) the limits of several areas of Vertisols were determined (Fig. 1). They cover a surface of approximatively 135 hectares and show great uniformity in a wide range of physical, chemical and hydrological features particularly conditioned by the strong presence of clay with shrinking and swelling properties. In the dry season topsoil dries up through evaporation. This process can cause cracks that reach up to one meter in depth and self-mulching which by falling into the cracks together with some crop tailing, give rise, by vertic movement, to the Vertisols homogeneity. This homogeneity is the main feature of the Vertisols at Pietranera farm. They have been classified as: Typic Pelloxererts, Chromic Pelloxererts and Typic Chromoxererts.

Their general features are represented by a soil profile of A-C type, nearly always Ap-C, of considerable depth and uniformity, frequently reaching two metres in depth. Even though the organic matter is only found in negligible quantities, it is always well humified and closely linked to the soil's montmorillonitic particles. It gives a good granular structure to the topsoil and the characteristic dark colour - often black. The nutrient content is quite good and is excellent in potassium. The reaction is sub-alkaline. The capacity for water retention is always high so that, with suitable dry-farming techniques they can stay fresh longer. However, in depressed areas, in winter months the water-table can sometimes be found near the surface, altering its structure and causing a diminution of its porosity. These phenomena become more accentuated when the salty phase is present. In some areas the stony phase appear.

The capability of the Vertisols at Pietranera farm is quite good. They respond well to fertilizers and allow the cultivation of a wide range of cereals, fodders, legumes and vegetables.

INTERGRADE

Intergrade soils show properties that may be the result of sets of processes that cause one kind of soil to develop from or toward another kind of soil, or otherwise to have intermediate properties between those of two or three great groups.

At Pietranera farm (Fig. 1) there are about 11 hectares of integrade between Vertic Xerochrepts and Entic Pelloxererts (Oliveri *et al.*, 1986). They evolve on calcareous marls and show an Ap-C moderately deep soil profile characterized by a lot of rock outcrop and stones. Their texture is sandy-clay-loam in the topsoil and tends to be clayey in the subsoil. The structure is of blocky type both angular and sub-angular. The reaction remains at sub-alkaline levels. The carbonate content is usually excessive while the fertility element content is variable. Drainage ranges from normal to low.

LIMITATION AND CAPABILITY OF THE SOILS

The soil survey at Pietranera farm provided knowledge about the different features of the soils themselves and about how to individuate areas which are affected by hazards which limit the cultural choice (Fierotti *et al.*, 1986; Dazzi, 1989).

These "critical-areas" on the farm can be easily focussed because they coincide with the soil-phase themselves.

Entisols for instance show hazards linked to rockiness or stoniness, to erosion phenomena or to high salinity level. Other limitations are due to the high amount of clay and sometimes to a shallow soil profile.

Owing to these limitations large areas of Entisols especially those with steep slopes are classified in VI and VII Capability classes.

Consequently the cultural choices are limited to fodder crops or to afforestation. The first results obtained by growing forage shrubs such as Atriplex show that shrub cover protects the soil against surface runoff and sheet erosion particularly in areas where erosion is worsened by salinity (Chisci *et al.*, 1991). The possibility of obtaining fresh forage for sheep should not be neglected.

Inceptisols depending on their physiographic position are subject to hazards due to erosion, salinity, rockiness as well as high level of clay and carbonates. To overcome these limitations it is necessary to protect against erosion by growing suitable crops in soils with high levels of clay and carbonates and that are salinity resistent. Inceptisols are classified in the II and, more often, in the III class of capability owing to these limitations.

The main limitations of Vertisols are linked to their high clay level which reduces drainage. In some areas such limitation is enforced by a salty phase. Therefore large areas of Vertisols belong to the II capability class while only restricted areas (especially those with the salty phase) are classified in the III capability class. An accurate choice of crops for these soils means they will be put to better use.

Intergrades are limited by shallow depth and sometimes by rockiness so agricultural management must take this into account. They are classified in the III capability class.

On the base of the above mentioned soil and capability features, Pietranera farm shows all the peculiar limitations to agricultural management that can be found in the large inland clayey area of Sicily and in the Mediterranean area as a whole.

In such areas which are accomunated by the same hazards for farming i.e. irregular morphologies, steep slopes, clayey soils with vertic features and by the frequent soil salinity, shrubs can play a determinant role towards the reclamation of the more degradated soils.

Moreover shrub cultivation can be considered a modern agronomic tool in the arable land production system.

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